

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY

RESOLUTION 94-089

IMPLEMENTATION OF SELENIUM MITIGATION FUND WORKPLAN

Whereas, on January 19, 1994, the California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Regional Board), approved litigation settlement brought by the Western States Petroleum Association and the six Bay Area oil refiners (Resolution 94-016); and

Whereas the settlement agreement provided for the payment of a total of \$2,000,000 to a "Selenium Mitigation Fund" in the Department of Justice Special Deposits Fund (hereinafter called the Fund) by the dischargers; and


Whereas \$200,000 of the total will be deposited in the State Water Resources Control Board's Cleanup and Abatement Fund; and

Whereas the balance of the monies (\$1,800,000) are specifically designated to be used for (a) technical review of selenium treatability studies being undertaken by the dischargers and the Western States Petroleum Association, (b) mitigation project(s), and (c) studies on the fate and transport of pollutants in San Francisco Bay; and

Whereas a workplan allocating the fund to each of the three designated uses and describing specific projects to be funded within each category has been prepared;

NOW, THEREFORE BE IT RESOLVED, that the Regional Board directs the Executive Officer to implement the attached workplan.

I, Steven R. Ritchie, Executive Officer, do hereby certify the foregoing is a full, true and correct copy of a resolution adopted by the California Regional Water Quality Control Board, San Francisco Bay Region on July 20, 1994.

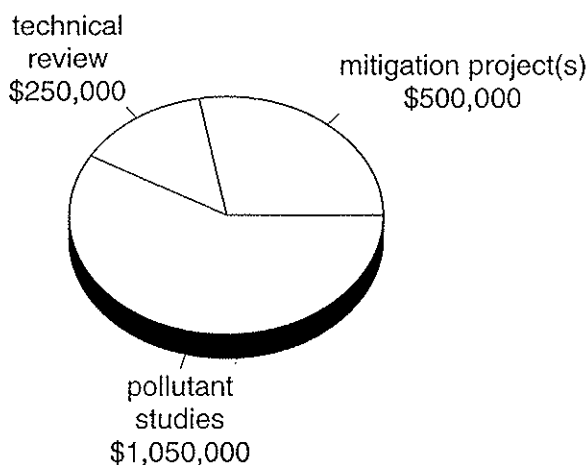

for STEVEN R. RITCHIE
Executive Officer

Workplan for Selenium Mitigation Fund

Introduction

As part of the settlement with the Western States Petroleum Association, the State will receive a total of \$ 1,800,000 to be used for (a) technical review of treatability studies of refinery wastewater, (b) mitigation project(s), and (c) studies on the fate and transport of pollutants in San Francisco Bay. Staff have prepared a general scope of work for each of the three designated uses of the fund. In addition, detailed specifications for the technical review contract and several pollutant fate and transport research projects have been written. The research component was designed to both provide critical information regarding selenium and extend consideration to the fate and transport of other pollutants in the northern reaches of the Estuary. We expect to obtain matching funds from other sources for most of the research projects and possibly the mitigation project(s).

The general allocation of the fund is depicted below:



Implementation of the workplan is scheduled in several stages. Contracting and detailed experimental design for the technical review contract and the sediment resuspension, resident bivalve (*Potamocorbula*), zooplankton scoping, and selenium fractionation research projects will be conducted during the first stage (scheduled for August-December, 1994). During the second stage, staff will indentify appropriate mitigation project(s), will be completed (scheduled for November, 1994- March, 1995). During the third stage, preliminary results from the first set of research projects will be used to refine multi-year studies and in the design of the biogeochemical cycling project.

The descriptions below identify general research goals and how the information will support water quality management in the Bay. Studies scheduled for startup in the first stage of workplan implementation are presented in more detail than others and have specific amounts allocated to them.

Technical Review

Work being conducted under the auspices of the Western States Petroleum Association and by

Shell, Exxon, and Unocal to develop and implement selenium reduction measures is scheduled to be completed in three phases: joint research on a wide range of treatment technologies (to be completed by September of 1995), pilot-scale tests at individual refineries (to begin no later than December, 1995), and lastly, implementation of reduction measures to be completed at individual plants no later than July, 1998.

The goals of the technical review are to assess (a) the scope, consistency, and technical quality of technology development; (b) availability of selenium emission reduction measures; and (c) the feasibility and comparative costs of implementing a range of measures at individual refineries.

Technical review of this work will require expertise in selenium chemistry and treatment, refinery process engineering, and economics beyond those possessed by Regional Board staff. Based on hourly rates of consultants with the appropriate level of experience and moderately conservative estimates of time requirements, a total budget of \$250,000 will be allocated for technical review over the period of the Cease and Desist Order (February, 1994-December, 1997). In the event that review does not require expenditure of the full amount in the budget, excess will be allocated to either the mitigation project or pollutant fate and transport studies.

Mitigation Project

Staff propose allocating \$500,000 of the fund to be used in mitigation projects. The amount was chosen because it is sufficient to complete a project without funding from additional sources, or could provide a significant contribution to a multi-party project.

Staff is initiating a process for selecting a specific project or projects early this fall and anticipate consideration of at least the following factors: environmental benefit, degree to which project meets critical need in the northern area of the Estuary, ability to complete project with available resources and/or potential for obtaining additional funding, and the degree to which a project involves the immediate local community and other public agencies. Recommendations on specific project proposals will be brought to the Regional Board in late 1994 or early 1995.

Pollutant Fate and Transport

Staff propose allocating \$1,050,000 to fund studies on the fate, transport, and cycling of selenium and other pollutants of concern in the Bay, according to the general research workplan outlined below. This research package was designed to provide critical information regarding selenium levels and effects in Estuarine organisms, extend those studies to include consideration of other pollutants and transport processes of high concern, build on past and ongoing research and monitoring efforts, and leverage matching funds when possible. In addition, a balance between extending current research and initiating new projects was sought. In compiling this set of studies, staff considered the actions and gaps in knowledge laid out in the San Francisco Estuary Project's Comprehensive Conservation and Management Plan, and critical information needs in other Board program areas (such as dredging). In addition, suggestions on appropriate selenium studies were solicited from CDFG, USFWS, NMFS, USGS, Lawrence Berkeley Laboratory, Interagency Ecological Studies Program, the National Biological Survey, and members of the environmental community.

The second general goal for the workplan was to choose a set of studies that were interrelated.

Staff considered two options for meeting this goal: (a) fund only those studies related to selenium in the entire Bay system, and (b) conduct studies on selenium and other pollutants of concern in a more narrowly defined geographical area. The proposed workplan emphasizes the latter by focusing on trace metal cycling in the water, sediment, and food chain in Suisun and San Pablo Bays. Concerns regarding selenium levels in the South Bay will be addressed partly by building flexibility into research projects (ie. a limited analytical budget for locating selenium "hot spots"), but primarily through existing nonpoint source and groundwater programs.

The proposed research plan addresses the following aspects of pollutant fate and transport: effect of high food chain levels on the reproductive success of birds nesting in the area, the uptake of selenium and other trace metals by resident benthic organisms, the cycling of trace metals between the biota, sediment, suspended sediment, and water column, and the transport of pollutants through sediment resuspension and deposition. All are interrelated and both draw upon and extend understandings of the relationships between pollutants and beneficial uses in the Bay. Two of the major study components (benthic organism uptake and the sediment resuspension/turbidity study) will be carried out by the USGS.

The selenium fractionation and biogeochemical cycling research projects will be conducted by a group of scientists at Lawrence Berkeley Laboratories (LBL) (who conducted work on selenium geochemical cycling at the Kesterson Wildlife Refuge), drawing on expertise of other researchers at UC Berkeley and UC Davis as needed. The zooplankton scoping study and effect research project(s) will be carried out by interagency research teams.

All detailed experimental designs and research results will be critically reviewed both by key personnel involved in other projects funded as part of the overall study, and by scientists with the appropriate expertise in each area.

Research Projects:

Each of the individual research projects described below will provide missing information on the fate and transport of selenium and other trace metals in the northern reaches of the Estuary. In addition, results from all individual studies are intended to be complementary.

(A) Field Investigation of Reproductive Success of Benthic-Feeding Fowl Nesting at Selected Sites in the Western Delta, Suisun Marsh, and San Pablo Bay.

This project would involve field surveys of nests along San Pablo Bay, Suisun Marsh, and the western Delta to determine egg success and survival of hatchlings, and to determine whether egg-effect ratios developed using data from birds in the Central Valley can be applied to estuarine birds. This survey would target the species considered most at risk for selenium-related reproductive effects (ie. benthic feeders).

Although short-term, field-based studies rarely yield conclusive information linking observable effects to individual pollutants, reproductive effects in wildfowl and fish are expected to yield the best indications of impacted beneficial uses. No field-based effects studies of wildfowl nesting in the Bay have yet been done and we expect the results of this study to provide information that will be useful in assessing the degree to which beneficial uses have been impaired. The USFWS is in the process of

developing a study plan that would include this research; we have allocated an initial \$15,000 of the fund as a state match for this research, conditional upon USFWS securing the remaining amount (Fed. FY '95).

(B) *Potamocorbula* Studies

Species of birds and fish that feed on this introduced clam have much higher body burdens of selenium than other organisms. The introduction of this extremely efficient exotic species may be partially responsible for high levels of selenium in the food chain. Objectives for this set of studies to be conducted by the USGS would be:

- i) compare concentrations of Se, Hg, other trace metals as well as spatial distributions of concentrations between *Potamocorbula* and transplanted organisms used in the Regional Monitoring Program (RMP). This would serve to validate RMP data against resident population, establish the groundwork for potential use of *Potamocorbula* as an indicator of loading, and lay the groundwork for determining extent to which selenium in the sediment (vs. selenium in pelagic organisms) is responsible for the high tissue levels observed in the clam.
- ii) determine geographic distribution and temporal variability of Se (and other trace metals) in *Potamocorbula* in Suisun and San Pablo Bays.

This study will provide information useful for assessing the degree of exposure of Bay organisms to selenium and other trace metals, the extent to which organisms used in the Regional Monitoring Program reflect conditions in resident organisms, and provide additional information regarding potential hot spots of contamination in the northern reaches of the Estuary. A total of \$250,000 has been allocated for this project.

(C) Suspended Sediment Analysis in Suisun and San Pablo Bays

Sediment resuspension in Suisun and San Pablo Bays as well as the rest of the Estuary is poorly understood. Since selenium and many other pollutants adsorb to suspended sediments in the aquatic environment, sediment transport is a critical component of pollutant transport. Working with the US Geological Survey, a program of research and monitoring will be developed to increase our understanding of the factors controlling sediment transport in the northern estuary. Components of the program will include the following :

- i. Time-series of suspended sediment concentrations will be measured using in-situ sensors at two channel stations, Mallard Island and Martinez. Results will be analyzed to determine factors controlling sediment resuspension. Short-term data collection was funded at these sites through another project, but a longer period of record is needed to evaluate the wide range of conditions in the Estuary.
- ii. Analysis of previously collected data. Time series data (collected spring of 1994) will be analyzed to evaluate factors controlling suspended sediment concentrations in Suisun Bay and inform the study design for subsequent work assessing sediment dynamics. In addition, vertical profile measurements taken using an upward-looking Acoustic Doppler Current Profiler will be

converted to suspended solids concentration based on calibration and used to calculate sediment flux.

iii. Additional work, based on the results of 2 above, to address the cycling of sediment between the channel and shoals or other issues related to sediment dynamics which arise either through this study or other studies in this workplan.

This work will complement similar ongoing monitoring and analysis in the South and Central Bays and contribute to estuary-wide evaluation of factors governing sediment resuspension. This general information will be useful in several different program areas. For dredging, a better understanding of resuspension will allow better predictions of dredging requirements. Information regarding sediment transport will also be useful for constructing models of particle-bound pollutant transport. A total of \$200,000 has been allocated to this project.

(D) Selenium Fractionation on Solids Partitioning to Sediment

The chemical form of selenium adsorbed to or incorporated in suspended particles (including inorganic particles, phytoplankton, and zooplankton) and sediment particles to a large extent determines the relative bioavailability and toxicity to higher organisms. The first objective of this project is to develop a comprehensive methodology for the fractionation and speciation of selenium with a focus on the shallow bay environments of Suisun and San Pablo Bays. The work will focus on establishing methods for extraction of selenium fractions from soils, sediment, and biological tissue, using X-ray absorption near-edge spectroscopy as a means of assessing the validity of developed methods and be conducted by the team of geochemical researchers at LBL who worked on the Kesterson project (LBL). The general purpose of this project is to determine to what extent the sediment is a source or sink of selenium in the Bay environment. This project would serve to provide indications of the relationship between selenium loading, resulting levels in the sediment, and rate at which those levels may change over time. The information will be useful for further development of mass-based regulation of bioaccumulative metals. A total of \$250,000 has been allocated to this project.

(F) Zooplankton Scoping Study

The current understanding of selenium in the Bay suggests that high tissue levels observed in waterfowl may be due more to exposure through the benthic than the pelagic food chain pathway. However, very little is known about contamination of primary consumer organisms and the resulting exposure of higher organisms such as chinook. The two objectives of this study are to assess the practicability of collecting and analyzing levels of selenium and other trace metals in *Neomysis* and larval anchovies, and to develop a preliminary estimate of contaminant levels in common food of juvenile chinook.

Results of this study may indicate that modelling transfer of trace metals along food chain pathways is feasible and potentially appropriate for developing site-specific objectives for bioaccumulative trace metals. A total of \$50,000 has been allocated to this scoping study. Expansion of this technique will be considered in the third implementation phase.

Summary

Each of the research projects outlined above would contribute to an overall understanding of the sources and sinks of pollutants of concern in the Bay system and the routes and magnitude of fish and wildlife exposure. The allocation of the Selenium Mitigation Fund and projected overall research budget is presented graphically below. Only those projects scheduled for immediate start-up have specific dollar amounts associated with them.

Selenium Mitigation Fund Allocation

